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*Ministry of Domestic Trade and Consumer Affairs Malaysia,
Intellectual Property Division*

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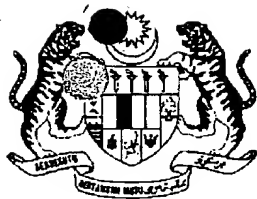
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PATENT APPLICATION NO: PI 2000 4199

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By authority of the
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ABDUL RAHMAN RAMLI
(CERTIFYING OFFICER)
2 April 2001



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CERTIFICATE OF FILING

APPLICANT : UNIVERSITI PUTRA MALAYSIA
APPLICATION NO : PI 20004199
REQUEST RECEIVED ON : 11/09/2000
FILING DATE : 11/09/2000
AGENT'S/APPLICANT'S FILE : ISD 426/13/1 (EPD/2000-6/29)
REF.

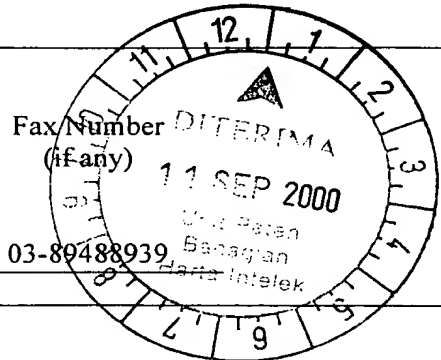
Please find attached, a copy of the Request Form relating to the above application, with the filing date and application number marked thereon in accordance with Regulation 25(1).

Date : 26/09/2000


.....
(HASNON BT. ALANG MOHD RASHID)
for Registrar of Patents

To : DR. MARGARET CHAI SOOK YIN
SIRIM BERHAD,1, PERSIARAN DATO'MENTERI,
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MALAYSIA.

Patents Form No. 1 PATENTS ACT 1983 REQUEST FOR GRANT OF PATENT [Regulations 7(1)] To : The Registrar of Patents Patent Registration Office Kuala Lumpur, Malaysia	<p align="center">For Official Use</p> APPLICATION RECEIVED NO.: <u>P200004199</u> Fee received on: <u>11.9.2000</u> Amount: <u>RM 730.00</u> *Cheque/Postal Order/Money Order/Draft/Cash <u>808 046144</u> Date of mailing :
Please submit this Form in duplicate Together with the prescribed fee.	Applicant's Reference : <u>ISD 426/13/1 (EPD/2000-6/29)</u>
THE APPLICANT(S) REQUEST(S) THE GRANT OF A PATENT IN RESPECT OF THE FOLLOWING PARTICULARS I. TITLE OF INVENTION : <u>PAVING COMPOSITION</u>	
II. APPLICANT(s) the data concerning each applicant must appear in this box or, if the space is insufficient, in the space below) Name : <u>UNIVERSITI PUTRA MALAYSIA</u> I.C./Passport No. : _____ Address : <u>43400 UPM Serdang, Selangor Darul Ehsan, Malaysia.</u> Address for service in Malaysia : <u>SIRIM Berhad, 1, Persiaran Dato' Menteri, Section 2, 40000 Shah Alam, Selangor Darul Ehsan, Malaysia.</u> Nationality : <u>A government organization in Malaysia.</u> * Permanent residence or principal place of business : <u>UNIVERSITI PUTRA MALAYSIA, 43400 UPM Serdang, Selangor Darul Ehsan, Malaysia.</u>	
Telephone Number (if any) <u>03-89486101 Extn. 2071</u>	Fax Number (if any) <u>03-89488939</u>
Additional Information (if any)	



III. INVENTOR

Applicant is the inventor

Yes

☐

No

☒

If the applicant is not the inventor :

Name of inventor : RATNASAMY MUNIANDY

Address of inventor : Universiti Putra Malaysia,
Department of Civil Engineering,
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A statement justifying the applicant's right to the patent accompanies this Form :

Yes

☒

No

☐

Additional Information (if any)

IV. AGENT OR REPRESENTATIVE

Applicant has appointed a patent agent in accompanying Form No. 17

Yes

☒

No

☐

Agent's Registration No. : PA/2000/0099

Applicants have appointed _____
to be their common representative

V. DIVISIONAL APPLICATION

This application is a divisional application

☐

The benefit of the
filing date

priority date

☐

of the initial application is claimed in as much as the subject-matter of the present application is contained in the initial application identified below :

Initial Application No. : _____

Date of filing of initial application : _____



20004199

VI. DISCLOSURE TO BE DISREGARDED FOR PRIOR ART PURPOSES

Additional information is contained in supplemental box :

(a) Disclosure was due to acts of applicant or his predecessor in title

☐

Date of disclosure: _____

(b) Disclosure was due to abuse of rights of applicant or his predecessor in title

☐

Date of disclosure: _____

A statement specifying in more detail the facts concerning the disclosure accompanies this Form

Yes

☐

No

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Additional Information (If any)

VII. PRIORITY CLAIM (if any)

The priority of an earlier application is claimed as follows :

Country (if the earlier application is a regional or international application, indicate the office with which it is filed) :

Filing Date : _____

Application No. : _____

Symbol of the International Patent Classification :

If not yet allocated, please tick

☐

The priority of more than one earlier application is claimed:

Yes

☐

No

☐

The certified copy of the earlier application(s) accompanies this Form:

Yes

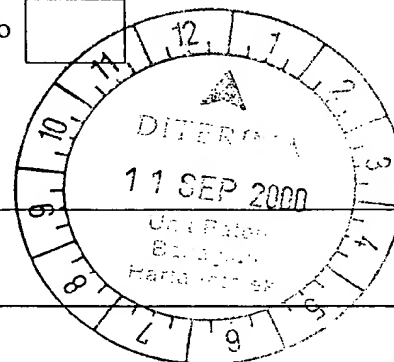
☐

No

☐

If No, it will be furnished by

Additional Information (if any)



20004199

VIII. CHECK LIST

A. This application contains the following :

1. request		Sheets
2. description	4	Sheets
3. claim	2	Sheets
4. abstract	1	Sheets
5. drawings	6	Sheets
Total	13	Sheets

B. This Form, as filed, is accompanied by the items checked below :

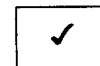
(a) signed Form No. 17



(b) declaration that inventor does not wish to be named in the patent



(c) statement justifying applicant's right to the patent



(e) priority document (certified copy of earlier application)



(f) cash, cheque, money order, banker's draft or postal order for the payment of application fee



(g) other documents (specify) – Form 5



IX. SIGNATURE

Margaret Chai Sook Yin

11/9/2000

DR. MARGARET CHAI SOOK YIN

**** (Applicant/Agent)**

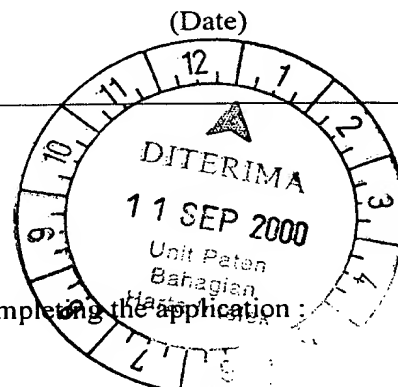
(Date)

If Agent, indicate Agent's Registration No. : PA/2000/0099

For Official Use

1. Date application received :

2. Date of receipt of correction, later filed papers or drawings completing the application :



* Delete whichever does not apply

** Type name under signature and delete whichever does not apply

20004199

PAVING COMPOSITION

Technical Field of The Invention

The present invention generally relates to a paving composition, in particular to stone mastic asphalt compound as a road paving composition.

5 Background of The Invention

Aggregate-containing asphalt has been employed as a paving composition for roads or the like for many years. The asphalt includes bitumens as a predominant constituent and is conventionally obtained as a solid residue from the distillation of crude petroleum. The asphalt is converted to a fluid state when paving a road. One fluid form is the suspension or
10 emulsion of the asphalt in water. After spreading and compressing the aggregate-containing asphalt, water evaporates and the asphalt hardens into a continuous mass.

The present invention is a new technology that utilizes a specific aggregate gradation and matrix for high stability. Specially formulated fibre mastic asphalt is used to hold the aggregate matrix in place while providing extended durability. The special formulation would
15 be able to handle heavy loading from commercial trucks and thus minimizing pavement surface distresses. Some of the major applications of this cost effective technology would be at traffic stop signs, exit and access ramps of highways, expressways, water ponding areas on highways, ascending and descending lanes, port areas with heavy container movements and parking lots. The use of the technology of the present invention is expected to reduce the cost
20 of the material by 15 to 20 per cent.

Summary of The Invention

Accordingly, it is the primary object of the present invention to provide a paving composition that has improved resilience and is able to handle heavy loading of commercial vehicles. It is also another object of the present invention to provide a paving composition that can
25 minimize pavement surface distresses and is economical to produce.

This and other objectives of the present invention is accomplished by,

A paving composition comprising aggregate and asphalt characterized in that:

- a) a major proportion of the composition by weight is aggregate; and
- b) a minor proportion of the composition by weight is asphalt.

- 5 The aggregate comprises particles of a size such that at least 80 per cent will be retained on a 2 mm sieve passing 19 or 20 mm sieve sizes, and about 60 to 75 per cent will be retained on a 7 mm sieve passing 19 or 20 mm sieve sizes.

The paving composition technology according to the present invention provides an economical means to produce paving composition that are resilient, capable of handling
10 heavy loading of commercial vehicles and providing a cost effective technology.

Brief Description of The Drawings

Other aspect of the present invention and their advantages will be discerned after studying the detailed description in conjunction with the accompanying figures in which:

Figure 1 is a schematic representation of a preferred embodiment of the paving composition
15 according to the present invention.

Figure 2 is a comparison between a magnified view of stone mastic asphalt according to the present invention and a magnified view of a conventional mix for road paving.

Detailed Description of The Invention

The aggregate used in the paving composition according to the present invention may be of a
20 type conventionally employed in the road building industry. It may range from fine particles, such as sand, to relatively coarse, ground particles such as crushed stone, gravel or slag.

As mentioned above, the paving composition according to the invention contains a major proportion by weight of aggregate; as is conventional for road paving compositions.

The paving composition according to the invention is generally used in a method of
25 producing a paving layer, which comprises applying a composition according to the invention to a substrate (such as the surface of a road) and curing the asphalt such that the aggregate in the paving layer is bonded together by cured solid asphalt.

Process

The paving composition of the present invention, stone mastic asphalt (SMA), is formulated with raw and processed materials using new techniques and processes, as shown in Tables 2 and 3. The details of the ingredients, mixing and compaction control processes are described below.

Aggregates

The aggregates for use in SMA should conform to the physical property requirement as shown in Table 4. The aggregates shall be heated up to a temperature of between 150°C and 200°C, prior to mixing with the mastic asphalt. SMA uses aggregates like granite, basalt, quartzite, industrial slag, crushed concrete, crushed bottles, sand and sludge stones from domestic wastes. The types, sizes, shapes and gradation of the aggregates to be used in SMA shall be as described in Tables 1 and 2. SMA uses specific gradation envelopes for different SMA products like SMA 14, SMA 12.5, SMA 10, SMA 7, and SMA 5.

Mastic Asphalt

An asphalt with a penetration between 80 and 100 (80/100) shall be stabilized or modified with tyre or latex powders of sizes 30 to 50 microns in a proportion of between 2 and 10 per cent by weight of asphalt and cellulose fibre pellets that form the asphalt or binder mastic. Rock or slag fillers may be used in place of the above in a proportion of between 4 and 10 per cent by weight of aggregates.

The main source of cellulose fibre are from oil palm, coconut, kenaf, rubber-wood and paper pulp, which are used in the formulation of fibre mastic. The cellulose fibres are specially ground and pulped to specific micron sizes that are found to give the best possible performance in terms of stability and drain down of asphalt. The cellulose fibres are mechanically pelletized with light asphalt emulsions or any other suitable materials, for easy packaging, storage and introduction into drum mix or batch mix plants. The proportion of emulsion to coat cellulose fibres is between 10 and 40 per cent by weight of fibres.

Mix Design and Control

Both the heated materials are mixed for a duration of between 30 seconds to 3 minutes before the specimen can be compacted. The specimen or mixed SMA compound shall be compacted

at a temperature not less than 130°C at 50 blows per side for normal use and 75 blows per side for heavy traffic loading.

SMA Mix Drain -down Analysis

- 5 The uncompacted hot samples are tested for their mastic asphalt drainability using stainless steel $\frac{1}{4}$ inch mesh baskets. The mix shall not drain down more than 0.3% maximum by weight of total mix.

Performance Testing

The compacted samples shall be tested for the following to ensure quality and durability:

Stability:

- 10 It measures the strength of the SMA paving compound after placing the specimen in a water bath of 60°C (service temperature of pavements) for about 30 minutes. The samples are expected to display a minimum strength of 7.0 kN with a flow that falls within 2 to 4 mm range. The specimen is also expected to have a design airvoids of between 3 and 5%.

Moisture Induced Test:

- 15 Tropical countries like Malaysia receives heavy rainfall that cause pavement damages due to moisture problems. SMA samples are expected to display a Tensile Strength Ratio (TSR) of at least 75%.

Modulus Values:

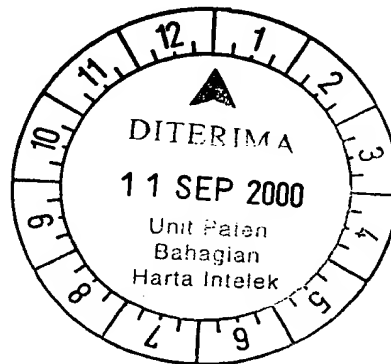
- 20 The resilient modulus of the compacted SMA shall attain a minimum value of 3000 MPa. The samples shall also display a minimum value of 10,000 load cycles to failure in terms of dynamic impact loading.

- 25 While the preferred embodiments of the present invention have been described, it should be understood that various changes, adaptations and modifications may be made thereto. It should be understood, therefore, that the invention is not limited to details of the illustrated invention shown in the figures and tables, and that variations in such minor details will be apparent to one skilled in the art.

Claims:

- 1) A paving composition comprising aggregate and asphalt characterized in that:
 - a) a major proportion of the composition by weight is aggregate; and
 - b) a minor proportion of the composition by weight is asphalt.
- 2) A paving composition as claimed in claim 1 in which the asphalt is present as a mastic.
- 3) A paving composition as claimed in claim 2 in which the asphalt mastic comprises additives to provide enhanced stability and drainability.
- 4) A paving composition as claimed in claim 1 in which the aggregate comprises particles of a size such that at least 80 per cent will be retained on a 2 mm sieve passing 19 or 20 mm sieve sizes, and about 60 to 75 per cent will be retained on a 7 mm sieve passing 19 or 20 mm sieve sizes.
- 5) A paving composition as claimed in claims 1 or 4 in which the aggregate is granite, basalt, quartzite, industrial slag, crushed bottles, crushed concrete, or sand and sludge stones from domestic wastes.
- 6) A paving composition as claimed in claim 3 in which the asphalt mastic comprises additives selected from the group consisting tyre powder, latex powder, rock filler, slag filler and cellulose fibre.
- 7) A paving composition as claimed in claim 6 in which the tyre or latex powders are of sizes 30 to 50 microns in a proportion of between 2 and 10 per cent by weight of asphalt and cellulose fibre pellets that form the asphalt mastic.
- 8) A paving composition as claimed in claim 6 in which the rock or slag fillers are present in a proportion of between 4 and 10 per cent by weight of aggregates.

- 9) A paving composition as claimed in claim 6 in which the cellulose fibre is selected from the group consisting oil palm fibre, coconut fibre, kenaf fibre, rubber-wood fibre and paper pulp fibre.
- 5 10) A paving composition as claimed in claim 9 in which the cellulose fibre is mechanically pelletized with light asphalt emulsions or any other suitable materials.
- 11) A paving composition as claimed in claim 10 in which the proportion of asphalt emulsion to coat the cellulose fibres is between 10 and 40 per cent by weight of fibres.
- 10 12) A method of producing a paving layer, which comprises applying a composition according to any one of claims 1 to 11 to a substrate and curing the asphalt such that the aggregate in the paving layer is bonded together by cured solid asphalt.
- 13) A paved layer which has been produced by a method according to claim 12.



ABSTRACT

PAVING COMPOSITION

The present invention relates to stone mastic asphalt compound which is produced using a new technique and process. The process utilizes a specific aggregate gradation and matrix for high stability. Specially formulated fibre mastic asphalt is used to hold the aggregate in place while providing extended durability. This formulation would be able to handle heavy loading from commercial vehicles and thus minimizing pavement surface distresses. The use of the present invention is expected to reduce the cost of materials by about 15 to 20 per cent.

(The most illustrative figure is Figure 1)

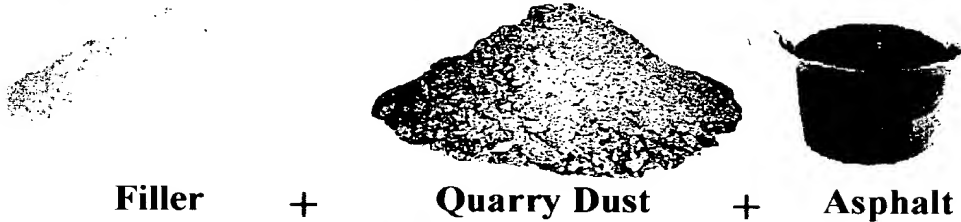
STONE MASTIC ASPHALT MIX DESIGN CONCEPT



Stone Skeleton or Matrix

Stone

+



Filler

+

Quarry Dust

+

Asphalt

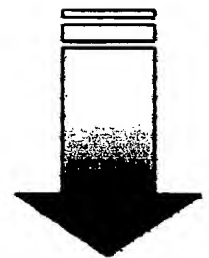
Mastic



+

Cellulose Oil Palm Fibre (COPF)

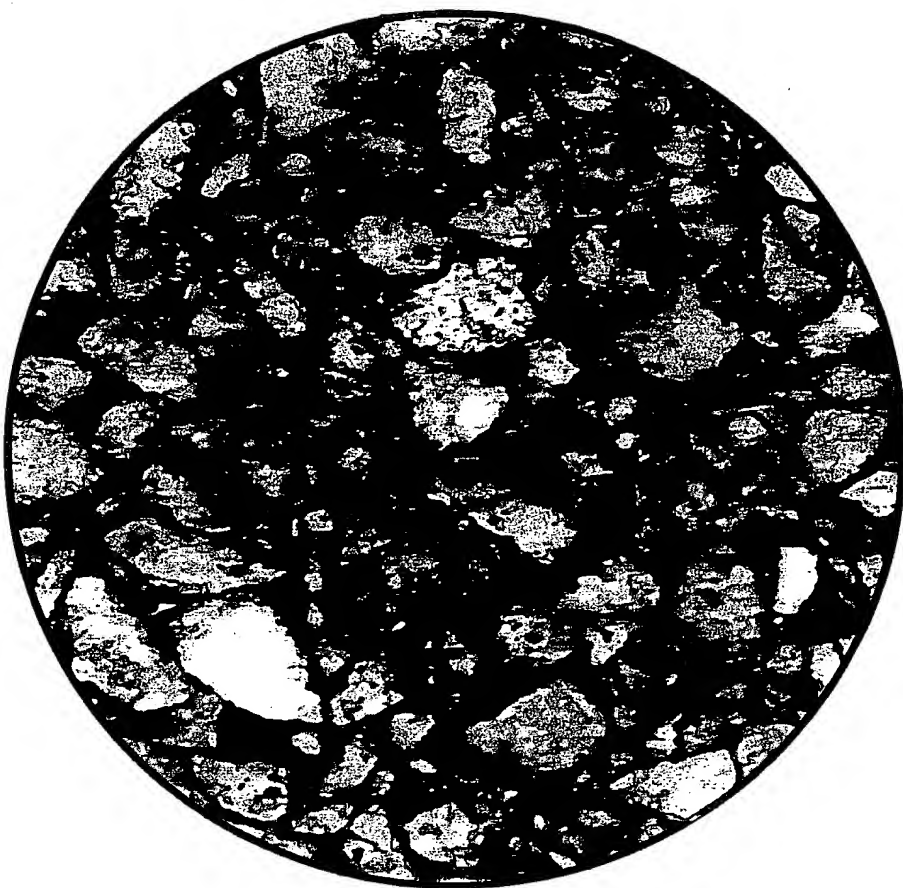
Mastic



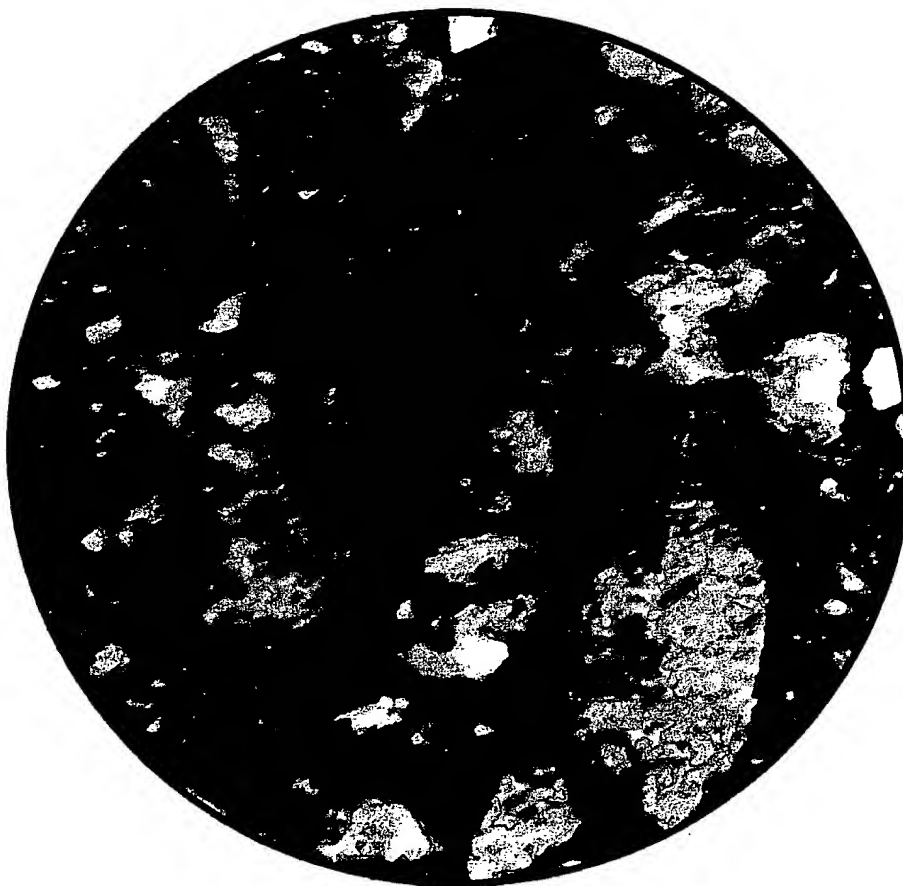
Stone Skeleton filled with Mastic

**Stone Mastic
Asphalt**

FIGURE 1



STONE MASTIC
ASPHALT (SMA)



CONVENTIONAL MIX

FIGURE 2

Table 1: SMA Aggregate Gradation Envelope

Sieve Sizes	SMA14 % Passing	SMA12.5 % Passing	SMA10 % Passing	SMA7 % Passing	SMA5 % Passing
19.0 mm	100	100			
14.0mm	80-100		100		
12.5mm		80-95			
10.0mm	60-95		80-96	100	100
9.50mm		71-90			
6.70mm	44-76		56-86	75-95	
5.00mm	30-56				65-95
4.75mm		40-70	46-60		
2.36mm	19-30	16-30	17-30	42-60	40-50
0.60mm	10-17	10-20	10-20	10-20	10-20
0.30mm	6-15	9-13	9-13	9-13	9-13
0.075mm	4-10	4-10	4-10	4-10	4-10

- The selection of the above sieve sizes and individual envelopes was developed after interactive research work at UPM Highway laboratory

Table 2: SMA Aggregate Proportions for SMA14, SMA12.5, SMA10, SMA7, and SMA5

Sieve Sizes	SMA14 % Retained	SMA12.5 % Passing	SMA10 % Passing	SMA7 % Passing	SMA5 % Passing
19.0 mm	60 - 70%	55-65%	50-60%	45-55%	40-50%
14.0mm	retained on	retained on	retained on	retained on	retained on
12.5mm	7.0mm sieve	7.0mm sieve	7.0mm sieve	7.0mm sieve	7.0mm sieve
10.0mm	passing 19 or	passing 19	passing 19	passing 19	passing 19
9.50mm	20 mm sieve	or 20 mm	or 20 mm	or 20 mm	or 20 mm
7.0mm	size	sieve size	sieve size	sieve size	sieve size
5.00mm					
4.75mm	80% or more	75% or more	70% or more	65% or more	60% or more
2.36mm	retained on	retained on	retained on	retained on	retained on
0.60mm	2.36mm or	2.36mm or	2.36mm or	2.36mm or	2.36mm or
0.30mm	2.0mm	2.0mm	2.0mm	2.0mm	2.0mm
0.075mm	passing	passing	passing	passing	passing
	19mm or 20	19mm or 20	19mm or 20	19mm or 20	19mm or 20
	mm	mm	mm	mm	mm

Table 3: SMA mix Design Parameter

Voids in Total Mix (VTM), percent	3 - 5
Asphalt Mastic Cement, percent	5.8 minimum
Voids in Mineral Aggregates (VMA)	16 minimum
Stability, kN	7.0 minimum
Flow	2 - 4 mm
Compaction, number of blows on each side of test specimen	50 for normal use and 75 for heavy duty
Drain-down of mastic asphalt, percent	0.35 max (2 hour reading)
Mastic Asphalt Heating temperature	155°C - 175°C
Aggregate Heating temperature	150°C - 180°C
SMA compaction temperature	135°C minimum
#40 tire rubber/latex powder, percent	2 - 10 by weight of 80/100 Asphalt
-#200 rock fillers	4 - 10 by weight of aggregates

Table 4: Aggregate Physical Properties

No.	Aggregate Tests	Quality Requirement
1	Los Angeles Abrasion	30% max
2	Sodium Sulfate Soundness loss	15% max
3	Aggregate Crushing Value	30% max
4	Absorption	2% max
5	Polished Stone Value	49 Minimum
6	Flatness & Elongation	3:1 ratio 25% max 5:1 ratio 10% max
7	Angularity Number	5 - 10
8	Specific Gravity	2.58 minimum

- The above aggregate properties can be confirmed by testing using ASTM, BS.MS or AASHTO standards